جامعة عبد المالك السعدي
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Université Abdelmalek Essaadi

Pole for Doctoral Studies
Center for Doctoral Studies Sciences, Technologies, and Medical Sciences

ANNOUNCEMENT OF DOCTORAL THESIS DEFENSE

Ms. RAISSOUNI Fatima Zahra

Will present here research work with the aim of earning a Doctorate

Doctoral program: Sciences, Techniques, and Medical Sciences
Discipline: Electrical Engineering
Specialty: Electronics and Optoelectronic communication systems

On 09/10/2025 at 10H00 at The Visio conference Room of the National School of Applied Sciences of Tangier, UAE
Under the Theme

Contributions to Vehicle to Vehicle (V2V) communication through automotive lighting

Front of the jury composed of :

First Name & Last Name	Establishment	Designation
Pr. EL OUALKADI Ahmed	ENSA of Tetouan, UAE	President
Pr. AYRIR Wiam	ENSA of Kenitra, UIT	Reviewer
Pr. BRAVO-MUÑOZ Ignacio	University of Alcalá	Reviewer
Pr. BRITEL Mohammed Reda	ENSA of Tangier, UAE	Reviewer
Pr. MARRON-ROMERA Marta	University of Alcalá	Examiner
Pr. MASSOU Siham	ENSA of Tangier, UAE	Examiner
Pr. GARDEL VICENTE Alfredo	University of Alcalá	Co-Supervisor
Pr. A CHERKAOUI Abdeljabbar	ENSA of Tangier, UAE	Supervisor
Pr. LAZARO GALILEA José Luis	University of Alcalá	Supervisor

Host Research Structure: Laboratory of Innovative Technologies (LIT) Abdelmalek Essaadi University and the GEINTRA Research Group University of Alcalá Spain

Abstract

The increasing demand for safe and efficient transportation systems has positioned Cooperative Intelligent Transportation Systems (C-ITS) as a central focus of research and development. In this context, Visible Light Communication (VLC), leveraging existing automotive lighting systems, has emerged as an alternative and/or complement to traditional radio frequency (RF) technology, particularly in Vehicle-to-Vehicle (V2V) communication. This dissertation explores the potential of VLC in this domain, addressing key challenges and proposing solutions that build upon each other.

To enable reliable VLC-based vehicular communication, it is essential to understand and model the behavior of the optical channel in outdoor environments. To this end, a channel modeling framework was developed based on a novel reflection model created by our research group. This model characterizes the interaction of light with different materials in vehicular environments, capturing the effects of multipath propagation. The resulting channel model not only quantifies the impact of multipath on communication performance but also provides a foundation for optimizing transmission strategies.

Building on the insights gained from channel modeling, the study investigates modulation schemes best suited for outdoor vehicular communication, where noise, interference, and rapidly changing channel conditions pose significant challenges. Several modulation techniques, including On-Off Keying (OOK), Binary Frequency Shift Keying (BFSK), Frequency Shift Keying (FSK), and Optical Orthogonal Frequency Division Multiplexing (O-OFDM), are evaluated. The objective is to identify the most robust schemes capable of maintaining stable and high-quality communication links under varying conditions.

Reliable communication is essential for advanced vehicular functionalities, making accurate vehicle positioning and inter-vehicle distance estimation critical for latency-sensitive applications like cooperative driving and platooning. Leveraging the previously modeled VLC channel characteristics and optimized modulation schemes, this research employs the Angle of Arrival (AoA) method to achieve centimeter-level precision. AoA stands out for its robustness and accuracy in dynamic vehicular environments, enabling precise angular measurements that ensure reliable and efficient positioning, a cornerstone for safety-critical automotive systems.

To validate the theoretical findings and proposed methodologies, real-world experiments were conducted in outdoor and semi-outdoor environments. These tests demonstrate the robustness, and practical feasibility of the proposed VLC system across various dynamic vehicular conditions. The results not only confirm the effectiveness of the developed models and techniques but also highlight the potential of VLC as a reliable and complementary communication technology for future intelligent transportation systems.

Keywords: V-VLC, V-VLP, V2V, C-ITS, Channel Modeling, Multipath, AoA, PSD sensor, Automotive Lighting